



C3104

Log Data Report

Borehole Information:

Borehole: C3104		Site: 216-B-38 Trench			
Coordinates		GWL¹ (ft):	Not reached		
North	East	Drill Date	TOC² Elevation	Total Depth (ft)	Type
N/A ³	n/a	8/01/01	n/a	259.6	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
CS threaded steel pipe	5 in.	10.75	9.25	0.75	0	58
CS threaded steel pipe	17 in.	8.375	7.825	0.5	0	111
CS threaded steel pipe	26.5	6.687	5.6785	0.5	0	259.6

Borehole Notes:

Ground surface is a gravel pad 1.5 to 2.0 ft thick.
This borehole is located 5.0 ft west of the "push" borehole C3340.

Logging Equipment Information:

Logging System:	Gamma 2B	Type:	SGLS (35%)
Calibration Date:	9/00	Calibration Reference:	GJO-2001-245-TAR
		Logging Procedure:	MAC-HGLP 1.6.5

Logging System:	RLS 1	Type:	Moisture
Calibration Date:	5/01	Calibration Reference:	RLSM00.0
		Logging Procedure:	MAC-HGLP 1.6.5

Logging System:	Gamma 1C	Type:	HRLS
Calibration Date:	9/00	Calibration Reference:	GJO-2001-244-TAR
		Logging Procedure:	MAC-HGLP 1.6.5

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4/Repeat	5
Date	8/06/01	8/06/01	8/06/01	8/06/01	8/07/01
Logging Engineer	Musial	Musial	Musial	Musial	Musial/Kos
Start Depth (ft)	0	18.5	42	53	58
Finish Depth (ft)	18	41.5	59.5	59	111.5
Count Time (sec)	200	30	200	200	200
Live/Real	R	R	R	R	R
Shield	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	1.0	0.5
ft/min	n/a ⁴	n/a	n/a	n/a	n/a
Pre-Verification	B00029CAB	B00029CAB	B00029CAB	B00029CAB	B00030CAB
Start File	B0029000	B0029037	B0029084	B0029120	B0030000
Finish File	B0029036	B0029083	B0029119	B0029132	B0030107
Post-Verification	B00029CAA	B00029CAA	B00029CAA	B00029CAA	B00030CAA

Log Run	6/Repeat	7	8	9	10/Repeat
Date	8/07/01	8/10/01	8/10/01	8/11/01	8/11/01
Logging Engineer	Musial	Musial	Pearson	Musial	Musial
Start Depth (ft)	106	110	173.0	219.5	115
Finish Depth (ft)	111.0	174	222.0	260	130
Count Time (sec)	200	200	200	100	100
Live/Real	R	R	R	R	R
Shield	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
ft/min	n/a	n/a	n/a	n/a	n/a
Pre-Verification	B00030CAB	B00032CAB	B00032CAB	B00033CAB	B00033CAB
Start File	B0030108	B0032000	B0032129	B0033000	B0033082
Finish File	B0030118	B0032128	B0032227	B0033081	B0033112
Post-Verification	B00030CAA	B00032CAA	B00032CAA	B00033CAA	B00033CAA

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2/Repeat	3	4/Repeat	
Date	8/07/01	8/07/01	8/11/01	8/11/01	
Logging Engineer	Musial/Kos	Musial/Kos	Musial	Musial	
Start Depth (ft)	58.0	105	110	230	
Finish Depth (ft)	111.25	110	260	245	
Count Time (sec)	n/a	n/a	n/a	n/a	
Live/Real	n/a	n/a	n/a	n/a	
Shield	N	N	N	N	
MSA Interval (ft)	0.25	0.25	0.25	0.25	
ft/min	1.0	1.0	1.0	1.0	
Pre-Verification	C009CAB	C009CAB	C0010CAB	C0010CAB	
Start File	C009000	C009214	C0010000	C0010601	
Finish File	C009213	C009234	C0010600	C0010661	
Post-Verification	C009CAA	C009CAA	C0010CAA	C0010CAA	

High Rate Logging System (HRLS) Log Run Information:

Log Run	1	2/Repeat			
Date	8/16/01	8/16/01			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	12.0	25.0			
Finish Depth (ft)	47.0	20.0			
Count Time (sec)	300	n/a			
Live/Real	R	n/a			
Shield	N	N			
MSA Interval (ft)	0.5	0.25			
ft/min	n/a	n/a			
Pre-Verification	D003CAB	D003CAB			
Start File	D003000	D003071			
Finish File	D003070	D003081			
Post-Verification	D003CAA	D003CAA			

Logging Operation Notes:

Spectral gamma data were collected in three surveys, one in each casing string as the borehole was advanced. The final SGLS survey was conducted on August 11, 2001.

SGLS log depths are relative to ground level. During logging run 3, a fine gain adjustment occurred at file B0029089 (45 ft). During logging run 4, a fine gain adjustment occurred at file B0029120 (53 ft). During logging run 8, fine gain adjustments occurred at files B0032111 (165.5 ft) and B0032125 (172.5 ft). SGLS surveys conducted on 8/11/01 (log runs 9 and 10) were erroneously conducted at an acquisition rate of 100 seconds real time.

Neutron moisture logs were run on 8/07/01 and 8/11/01 using the RLS 1 through one string of drill pipe. Log depths are relative to ground level. The neutron moisture tool was run centralized.

Two strings of casing were removed from the borehole prior to running the HRLS. High rate logging was not performed in this casing string when it was initially installed because the inside of this casing string has the potential for internal contamination. The HRLS tool was covered with a plastic bag, because this borehole has a potential for internal contamination. The outside temperature was extremely hot (>100 °F) during logging, which appears to have caused some minor gain drift during the pre-run verification and spectra collected early in the log run. Fine-gain amplifier adjustment after files: D003003 at 13 ft; D003008 at 16 ft; D003013 at 18.5 ft; D003048 at 36 ft.

Analysis Notes:

Analyst:	Sobczyk	Date:	08/22/01	Reference:	MAC-VZCP 1.79, Rev.2
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Pre-run and post-run verification spectra for the SGLS were evaluated. All of the pre-survey verification spectra were within the control limits. The post-survey verification spectrum for logging run 1 (file B00030CAA) was the only post-survey verification spectrum that was outside of the control limits. The full width half maximum (FWHM) for the 1461-keV peak and the 2614-keV peak were above the upper control limits for this post-run verification spectra. Examinations of spectra indicate that the detector appears to have functioned normally during the log run. Individual spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for a casing thickness of 0.75 inches from the surface to 58 ft and for a casing thickness of 0.50 inch from 58 to 260 ft. A correction for water in the borehole was necessary. Dead time corrections were necessary in portions of the borehole above 47 ft. The hole was open

each drill string at 58, 111, and 259.6 ft, and the change in drill strings is apparent in the logs as a slight increase at the end of the drill string and a decrease at the beginning of the log run while in double casing.

The first and second reruns of the SGLS show good repeatability. On the third rerun of the SGLS, data collected using a 100-second count time (rerun) compares well with data collected using a 200-second count time (original log run) except on the ^{40}K curve at 122.5, 124, 126.5, 127, and 129.5 ft. These discrepancies may be related to the shorter counting time used on the repeat log.

The High Rate Logging System (HRLS) was run in the interval from 12 to 47 ft. Data were collected in the interval of the SGLS high dead time ($> 40\%$) and indicates that ^{137}Cs reaches activities of about 100,000 pCi/g between 18 and 35 ft. This high rate zone contains activities of ^{137}Cs that are beyond the operating range of the SGLS. At lower activities of ^{137}Cs , there is good agreement between the SGLS and HRLS in the interval between 42 and 47 ft.

Moisture calibration models at Hanford for 6-in.-diameter casing with 1/2-in. thickness have not been established; however, calibration models have been established for 8-in.-diameter casing with 0.322-in. thickness and 6-in.-diameter casing with 0.28 in. thickness. A casing thickness correction (relative to 8-in.) casing can be estimated. Thus, the neutron log was processed for the portion of the hole with 6-in. casing to estimate volumetric moisture content with the established 6-in. hole-size correction and the 0.50-in. casing thickness for 8-in. diameter casing. A casing correction factor of 1.2 was applied to account for casing thickness. Neutron data are also presented as gross counts. In general, an increase in neutron count is indicative of an increase in moisture content.

The first rerun of the neutron-moisture tool shows good repeatability. On the second rerun of the neutron-moisture tool, the rerun appears to read about 10 cps higher on the rerun than the original run.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K , ^{232}Th , ^{238}U , and associated decay progeny), and man-made radionuclides. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and does not include errors associated with the inverse efficiency function, dead time correction, or casing and water corrections. These errors are discussed in the calibration report. Total gamma is plotted at both linear and logarithmic scales. The linear scale shows subtle variation in low count rate intervals while the log scale shows the high count rate intervals. A combination plot is also included to facilitate correlation. A neutron moisture log of volume percent moisture is also shown on the combination plot.

Results and Interpretations:

The man-made radionuclides ^{137}Cs and ^{60}Co were detected in this borehole. The high gamma activity between 13 and 45 ft is attributed to ^{137}Cs activities greater than 1,000 pCi/g. High rate logging indicates that ^{137}Cs reaches activities of about 100,000 pCi/g between 18 and 35 ft. In addition, ^{60}Co was observed in the intervals from 44 ft through 71.5 ft and at 115 ft at about 0.1 pCi/g. ^{60}Co may also be present higher in the borehole but was not observed due to the high recorded dead time due to the high levels of ^{137}Cs activity. Deeper in the borehole, ^{137}Cs activity was observed at 217.5 ft with a measured ^{137}Cs activity of about 0.2 pCi/g.

Other than the zones containing man-made radionuclides, the changes in gross gamma counts depend primarily upon changes in ^{40}K activities. There is an increase in ^{40}K from about 14 pCi/g above 12 ft to about 19 pCi/g below 43 ft. This increase in apparent ^{40}K activity occurred within the interval of high dead time, which was due to high ^{137}Cs activity. The increase in gross gamma counts from 130 to 145 cps at a log depth of 217 through 220 ft corresponds to an increase in gross neutron counts per second. ^{137}Cs was detected

within this zone at 217.5 ft with an activity of 0.2 pCi/g. Below 220 ft, gross gamma counts average about 25 cps less than that measured above 215 ft.

The elevated neutron counts per second that occur at about 115 ft and 219 ft correspond with intervals of man-made radionuclides. At 115 ft, ^{60}Co was detected at 0.1 pCi/g. ^{137}Cs was detected at 217.5 ft. The natural radionuclides do not show any apparent changes in these intervals. The elevated neutron count rate at 109 through 111 ft is probably related to the bottom of the second casing string.

¹ GWL – groundwater level

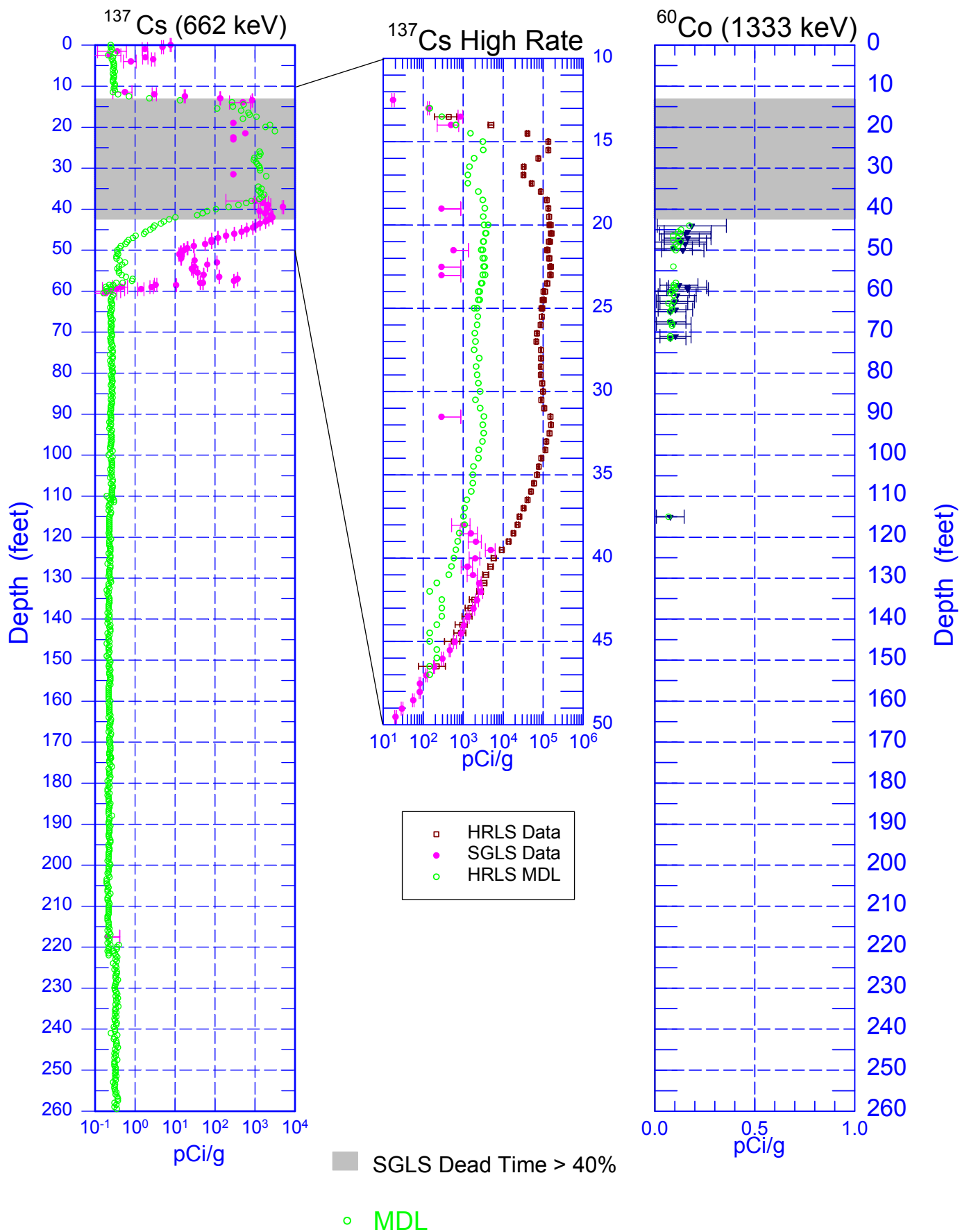
² TOC – top of casing

³ N/A – not available

⁴ n/a – not applicable

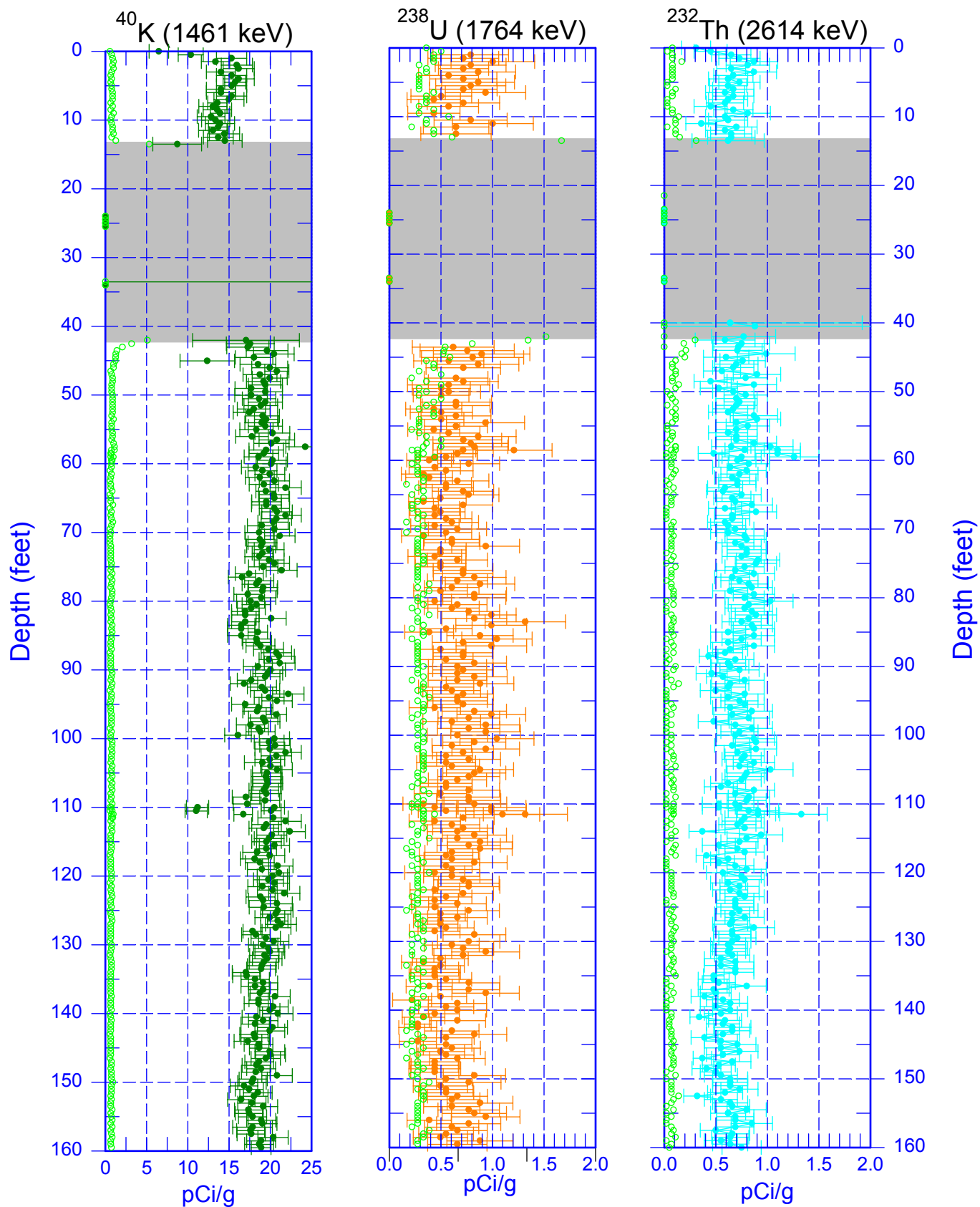
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Man-Made Radionuclide Concentrations



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Natural Gamma Logs

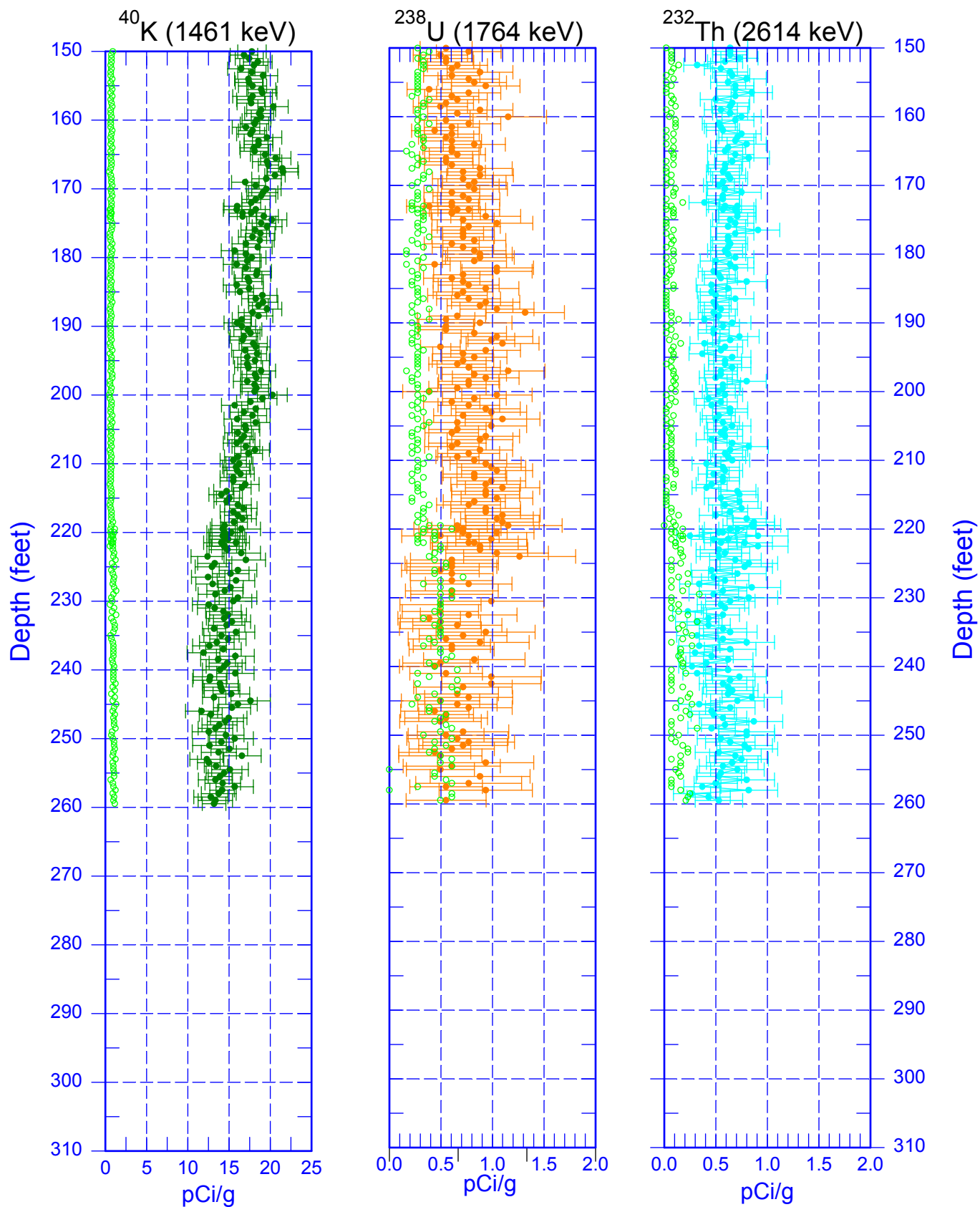


Dead Time > 40%

MDL

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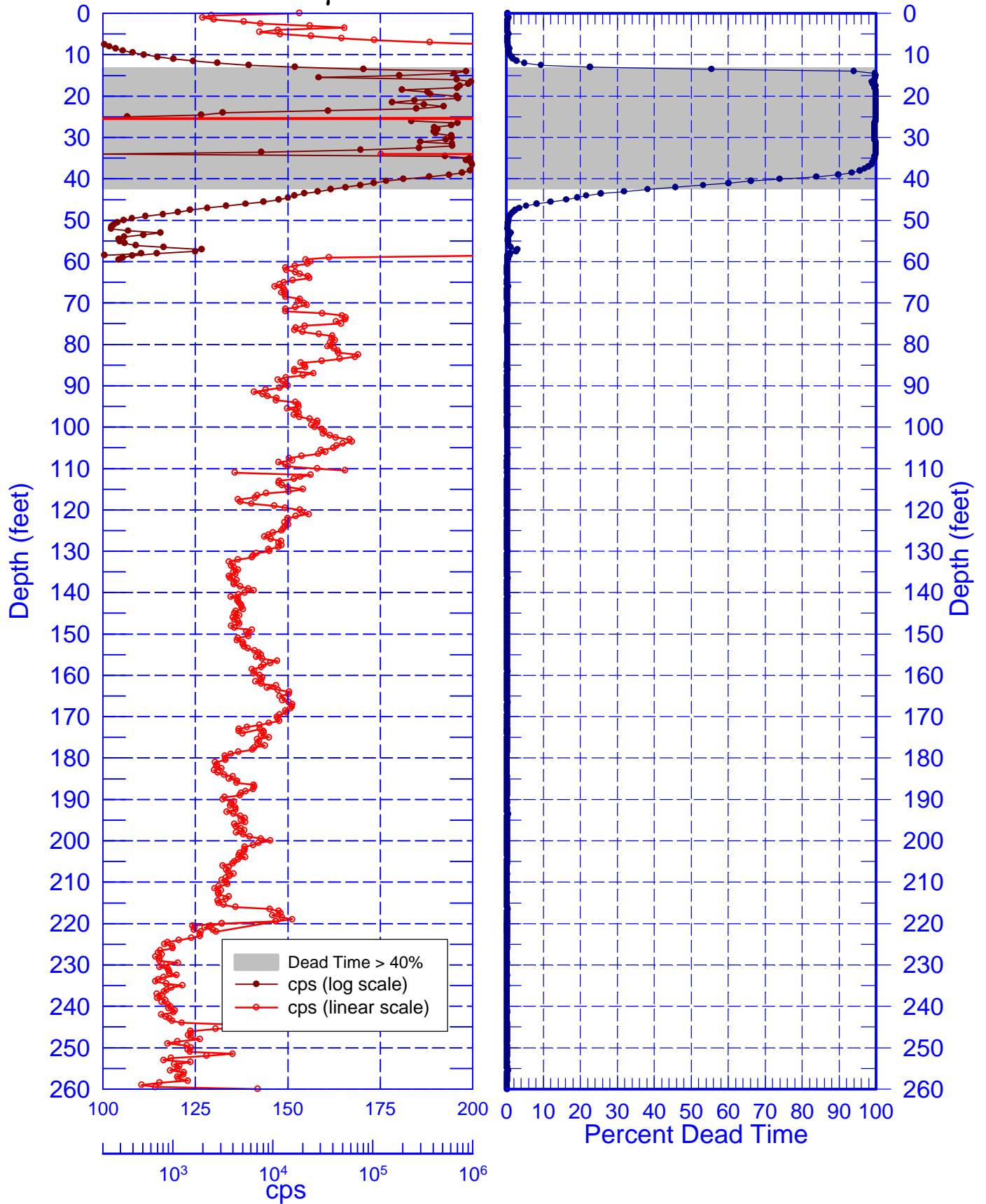
Natural Gamma Logs



○ MDL

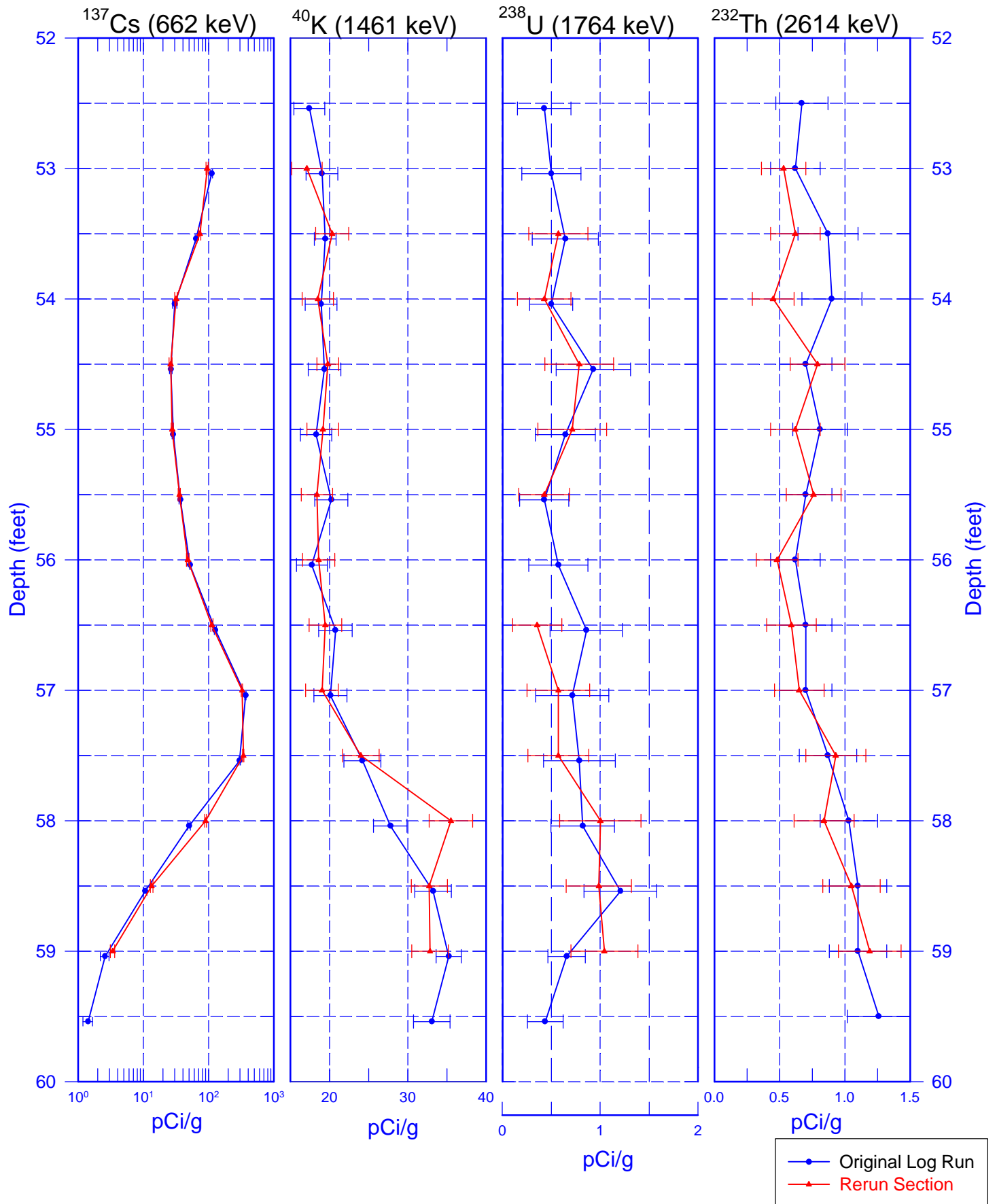
Total Gamma & Dead Time

Dead Time



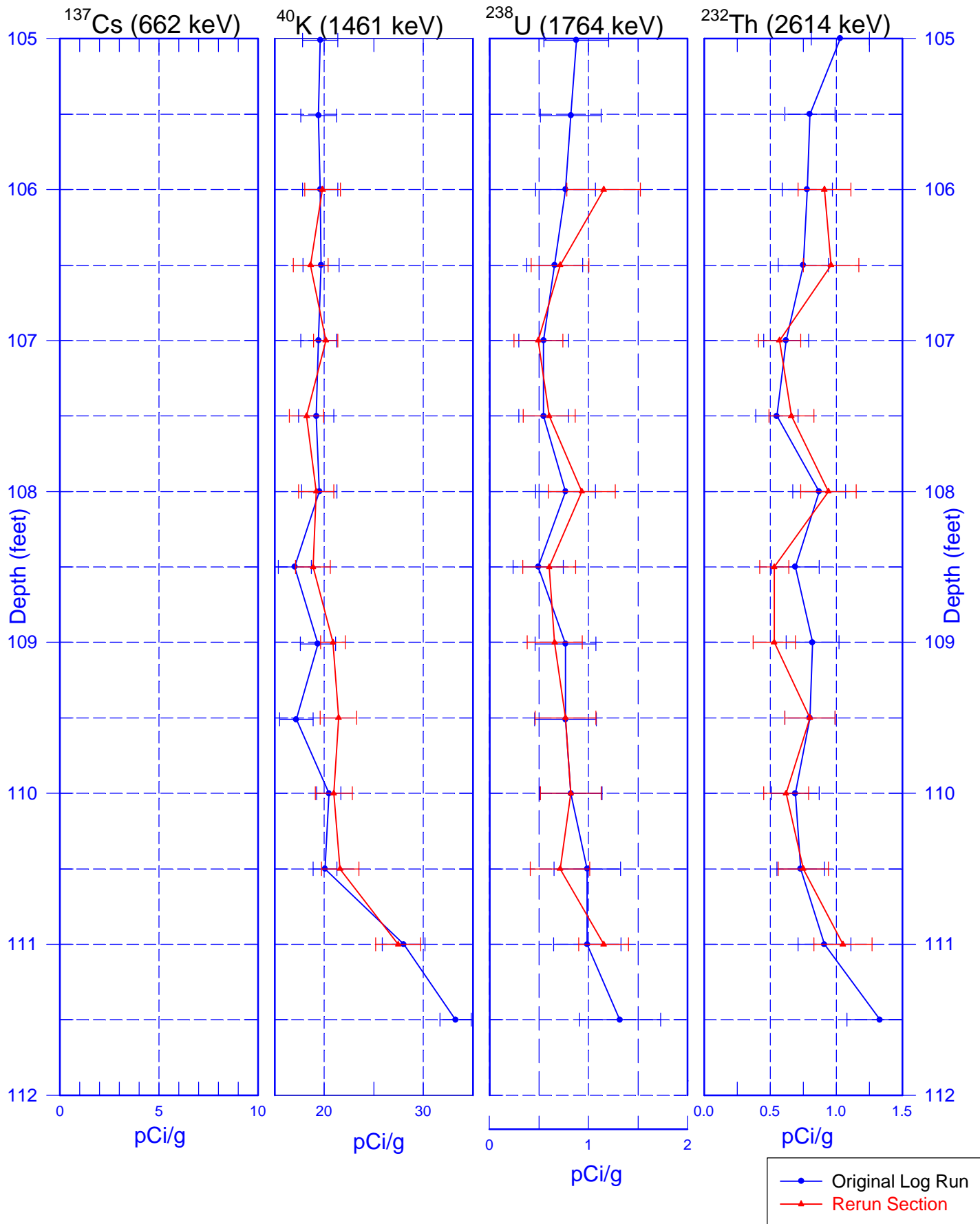
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First Rerun Section of Spectral Gamma Logs



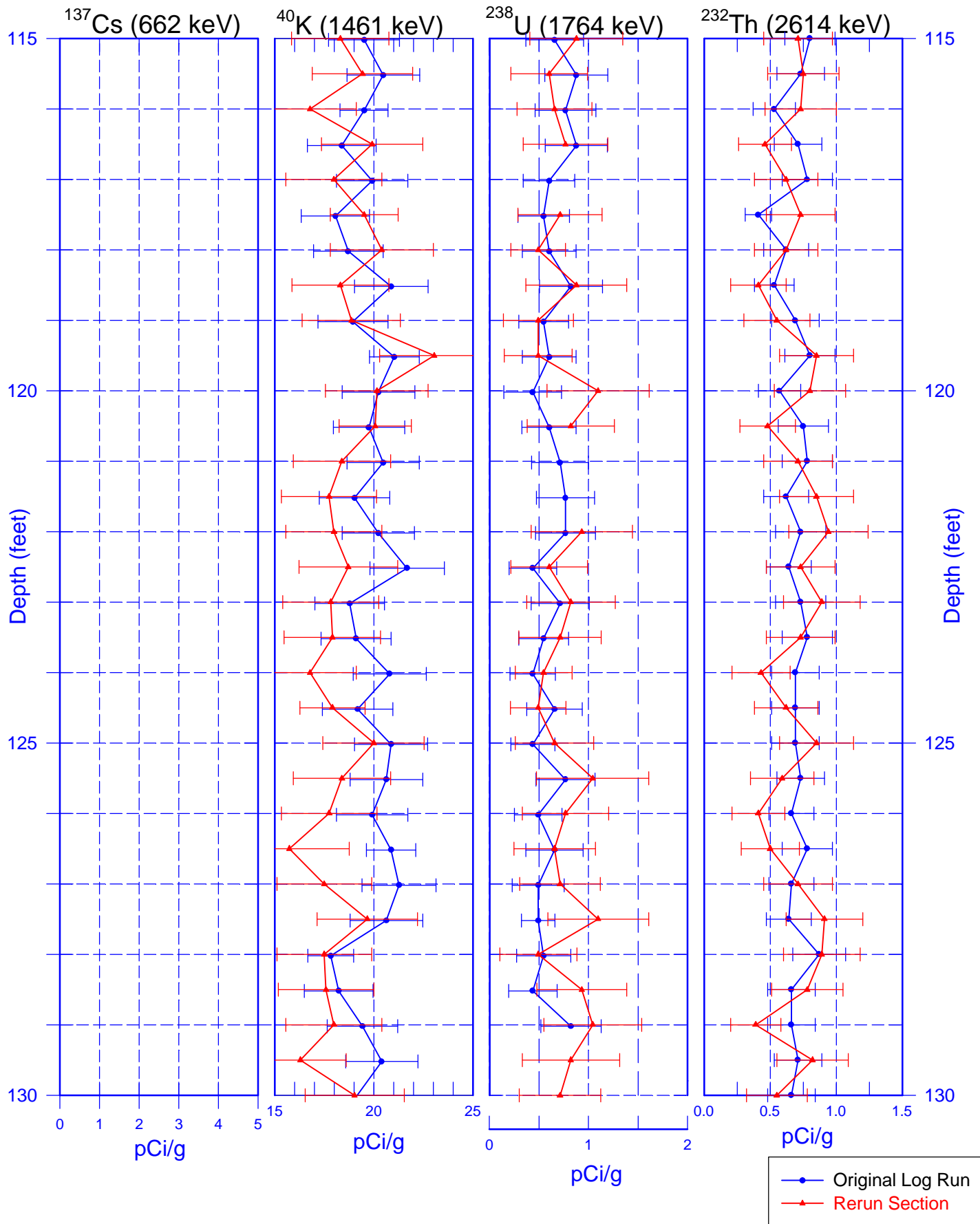
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Second Rerun Section of Spectral Gamma Logs



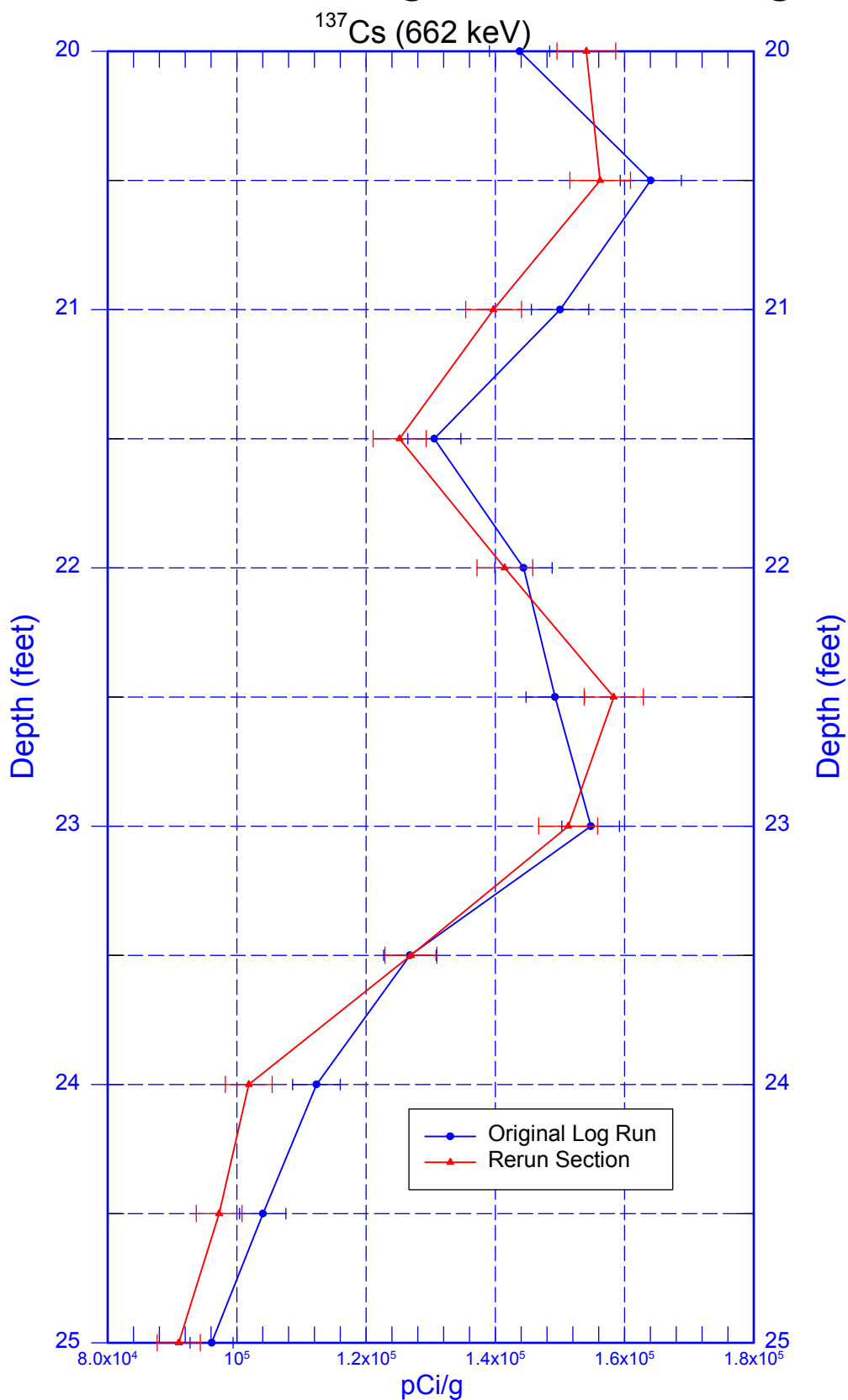
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Third Rerun Section of Spectral Gamma Logs



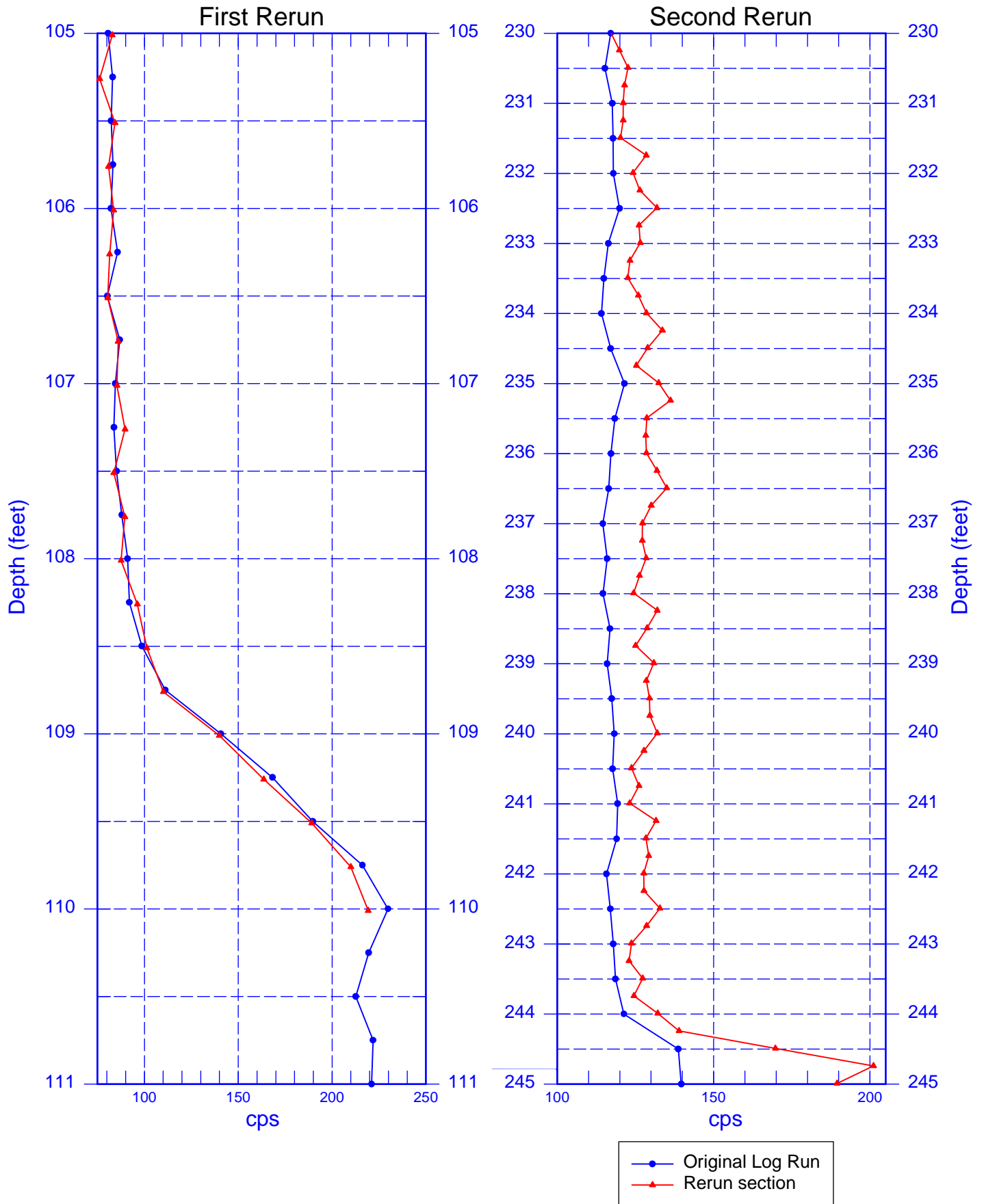
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Rerun Section of High Rate Gamma Logs



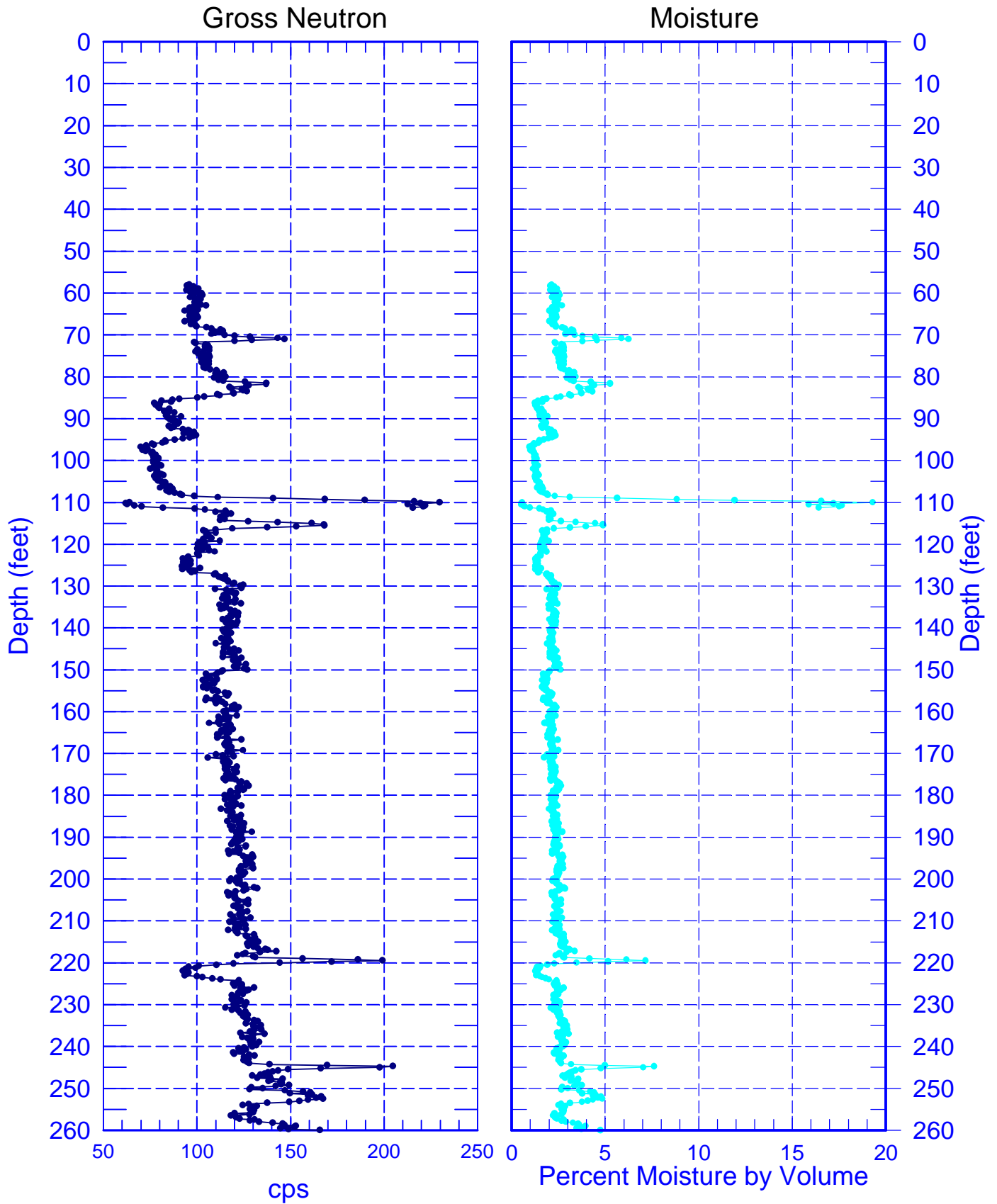
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Rerun of Neutron Logs



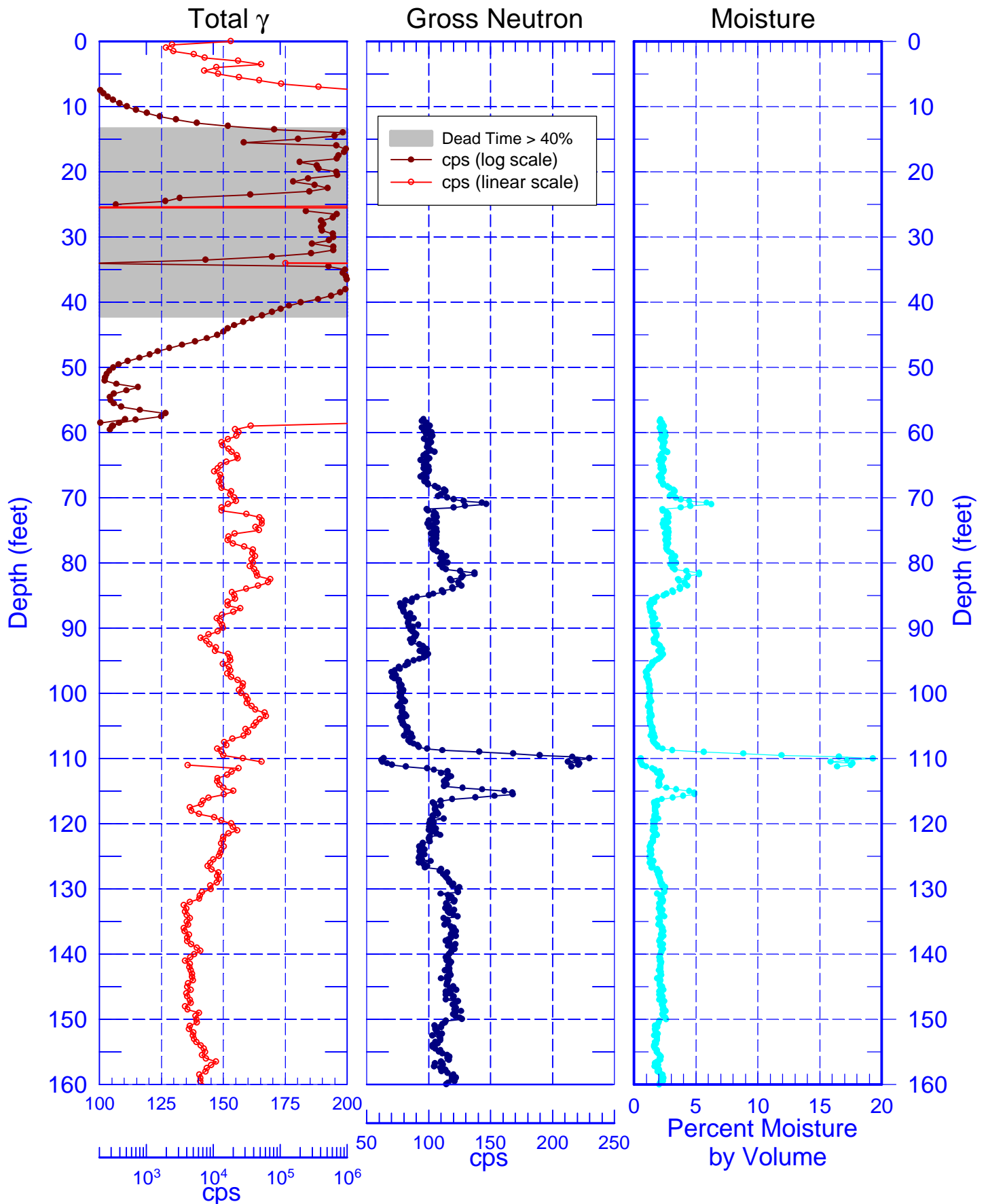
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Gross Neutron & Volumetric Moisture



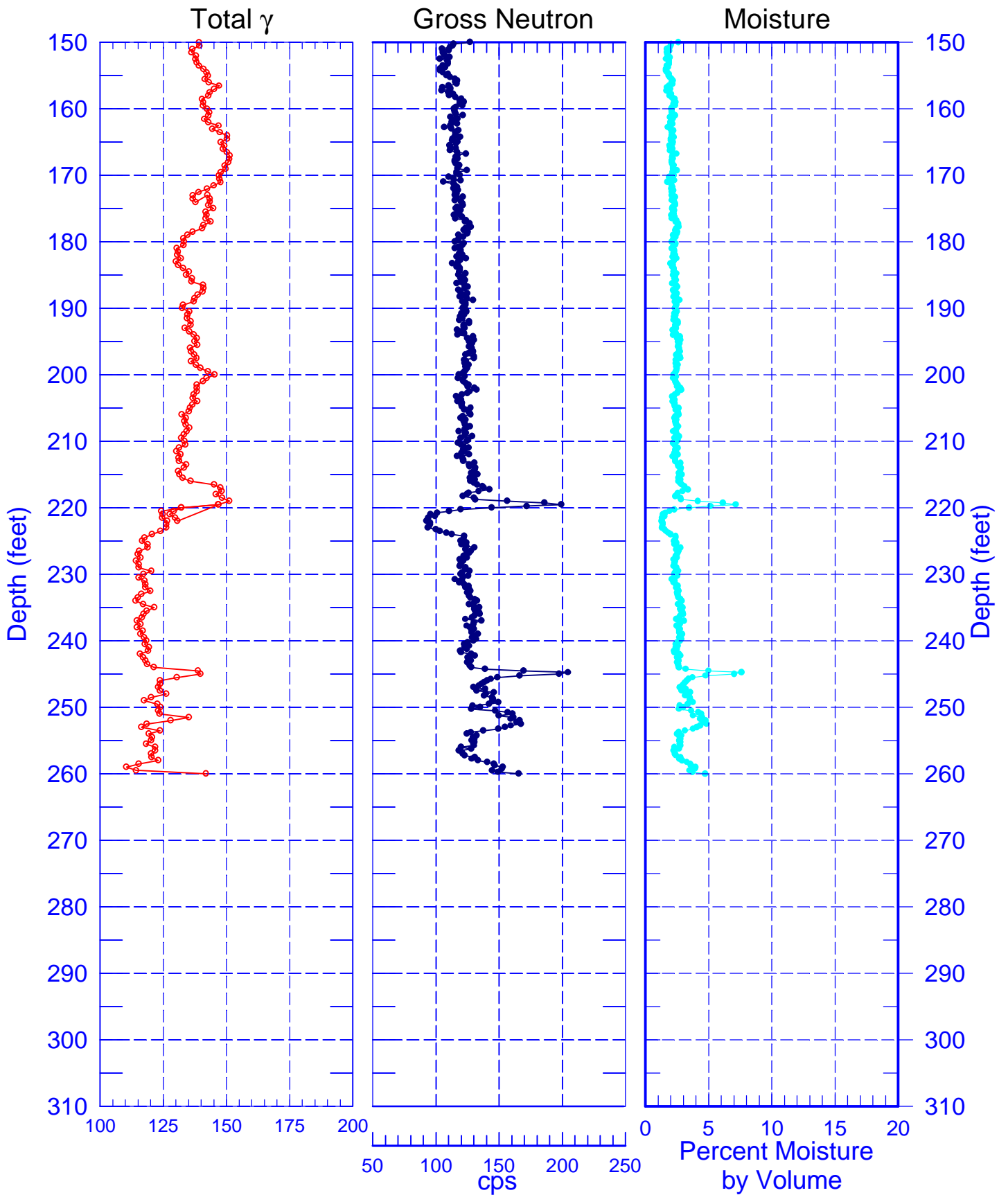
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Total Gamma & Gross Neutron

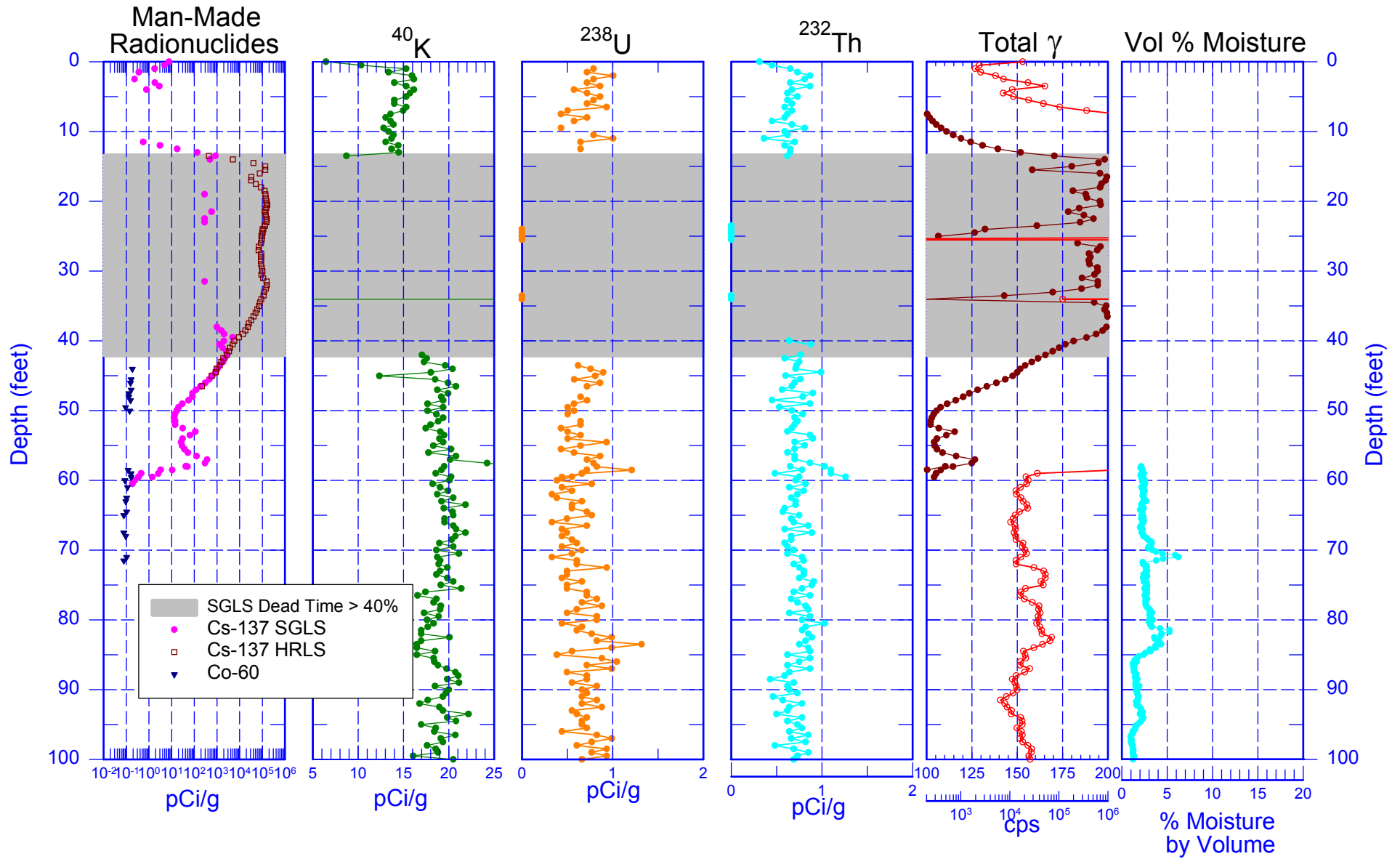


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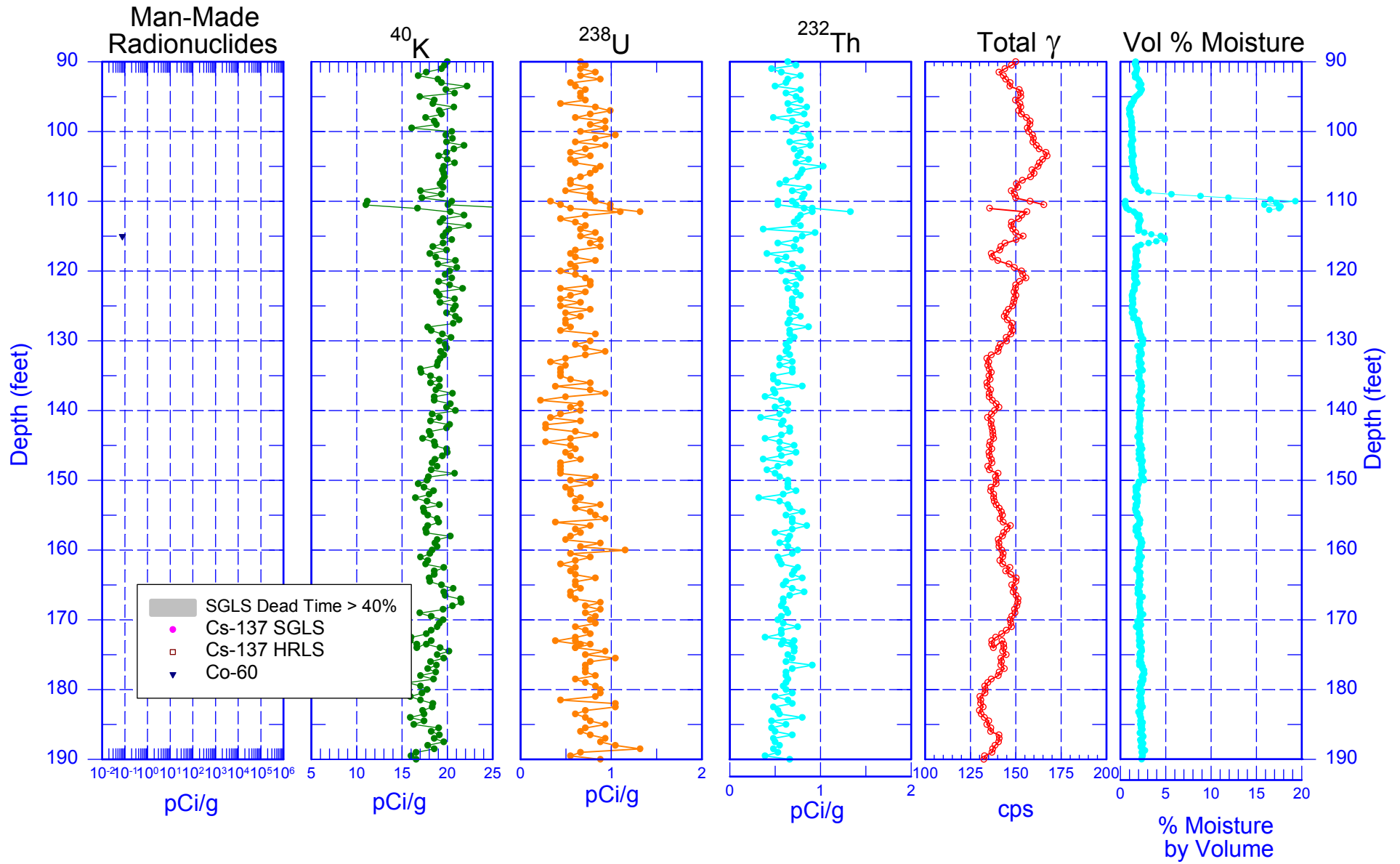
Total Gamma & Gross Neutron



C3104 Combination Plot



C3104 Combination Plot



C3104 Combination Plot

